Chapter 4. Change Management[1]

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Change management, which falls within the broader theoretical framework of social change (Lewin 1951, 1958), has been a perennially popular topic in the organizational effectiveness and management literature. Identifying the need for organization-wide change, and leading organizations through that change is widely recognized as one of the most critical and challenging responsibilities of organizational leadership. These responsibilities have become even more important in recent years as organizations are

> …living through a time of tremendous sea changes…. Globalization, the disruptive influence of new technologies, the emergence of e-business, and growing electronic connectivity among far-flung financial markets are all accelerating the pace of commerce throughout the world today – in virtually every industry. Add deregulation, political instability, emerging new economies in the Pacific Rim, and an exploding number of new scientific discoveries (many of which lead quickly to new products and commercial applications), and you have a recipe not only for market turbulence, but also for … "disruptive phase shifts" in how business is conducted. (Burke and Trahant 2000:xi).

The need to deal with disruptive phase shifts is as true for public science organizations as it is for private sector business organizations. Familiarity with this literature can help managers of science organizations prepare themselves and their organizations to deal more effectively with the challenges of intentional organization-wide change by understanding the factors that stimulate organizational change, the types of changes initiatives that other organizations have used to respond to such stimuli, and the lessons learned about implementing those changes and about managing the behavioral, motivational, and performance dynamics that arise during the change process.

Efforts to design and implement change across federal agencies have included, most recently, the "re-invention" strategies of the early and mid-1990s and current strategies resulting from the President's Management Agenda. Such efforts usually focus on streamlining, achieving more with fewer resources, modernizing structures and processes, and aligning public-service goals (perhaps new goals) with outcomes. These kinds of changes fit the definition in the change management literature of intentional, organization-wide change that is undertaken to achieve some organizational goal. This focus on managing change in the organization as a whole, rather than change that pertains to small work groups or single departments, represents a significant departure from past managerial thinking (Greiner 1967:119) and highlights the relationship between strategy and change management. The need for intentional organization-wide change in science organizations can result from changing internal conditions (for example, transitions within the organizational life cycle or changing goals, budgets, or missions) or changing external conditions (for example, transformations due to new technologies, policies, regulations, economic conditions, or international events). Presidential directives and federal legislation such as the Government Performance and Results Act have the potential to provoke large-scale organizational changes in science-funding and science-performing organizations.

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[1] Related chapters include: Strategy, Leadership, Competencies, Organizational Communication, and Participative Management

Over the past several decades, there has been an increasing interest in understanding how organizations evolve over time – adapting or failing to adapt, initiating change and responding to change – and in the cumulative, system-wide consequences of individual organization's responses, both planned and unplanned. Mohrman and Mohrman (1993:87) echo many others in observing that "organizational environments have become less benign, more complex, more interconnected, and more dynamic"…producing conditions that "pose the need for change while making it difficult to learn and change by overloading the information-processing capabilities of organizational members." Provoked by the challenges posed to American industry, first by the success of Japanese firms and the Asian economies and then by the "disruptive" technological innovations of the new economy, the recent literature on change management has tended to argue that organizations are facing an accelerating and pervasive need for continual, and increasingly rapid and dramatic, change (see for example Drucker 1980; Fradette and Michaud 1998; Miller and Morris 1999; Mohrman et al. 1989). This has led to greater attention to the tension between vision-led and problem-driven change strategies.

Recent articles by Christensen and Overdorf (2000), Miller and Morris (1999), and Tushman et al. (1997) illustrate the imperative for, and the challenges of, managing organizations through periods of disruptive change in the external environment, such as that currently being experienced as a consequence of globalization, advancements in communications and information technologies, changing international relationships, and breakthroughs in the biological sciences. This has been identified as particularly true for research and development organizations, which have a high need to be flexible, innovative, learning organizations (Sapienza 1995; Senge 1990; Hargadon and Sutton 2000). Adding to the challenge, the literature clearly demonstrates that the attributes that enable an organization to be successful at one stage in its lifecycle or in a particular historical context do not ensure success in another.

Recent change management literature has focused primarily on the private sector, targeted to those trying to lead organizations through organization-wide change processes (Goodstein and Burke 1995; Mohrman, Jr. et al. 1989). The goal of the intentional organizational change typically addressed in this literature is to make rapid improvements in economic value while simultaneously creating an organization whose structure, processes, people, and culture are tailored appropriately for its current mission and environment and positioned to make the next round of needed change (Beer and Nohria 2000). Two levels of intentional change are typically discussed (Burke and Trahant 2000; Beckhard and Harris 1987; Bridges 1995): (1) fundamental or transformational (addressing "big picture" issues such as mission, strategy, culture, leadership, external environment); and (2) transitional or transactional (the everyday, how things get done issues such as structure, management practices, systems, motivation, needs, job fit, and work unit climate).

The literature addresses four principal aspects of change management: theoretical models and frameworks that reveal and guide organization members' and researchers' thinking about organization change, approaches and tools, factors important to successful change management, and the outcomes and consequences of the change management process. A key point reflected throughout this literature is that planned change, and hence the skills and tools used, need to be tailored to meet the specific needs of the organization within its particular context (Goleman 2000; Greiner 1998; Adizes 1999; Christensen and Overdorf 2000; Enriquez and Goldberg 2000; Lawler et al. 2001).

Theoretical Frameworks and the Factors that Stimulate Organizational Change

Theories about organizational change implicitly or explicitly include assumptions about what an organization is and its relationship to its environment. Dooley (1997) Hage (1999:614-616), and Haveman (2000) articulate this relationship for some of the organizational theories influential in the organizational change literature. An organization may be seen as

- An "organism" that adjusts or evolves in response to fluctuations or contingencies in the environment and simultaneously influences its environment. In stable and certain situations, mechanistic organizational forms are appropriate, but in unstable and uncertain markets, an organic organizational form is more appropriate.
- An entity that must adapt to its environments through testing in a Darwinian sense – firms with inferior structures and/or practices die in a resource-constrained competition, and both planned and unplanned variation is introduced in a cycle of variation-selection-retention.
- An institution influencing and influenced by its context (Powell and DiMaggio 1991, DiMaggio and Powell 1983, and Zucker 1987).
- Defined by its ability to change their information-processing capabilities. Because of bounded rationality, heuristics are seen as dominating organizational decision making and thus organizational change in this approach.
- Political, that is, those departments or occupations that handle the major contingency facing the organization will become the dominant coalition and exert their power to maintain dominance. A variant of this is resource dependency theory.

Theories about change at the individual level underlie much of the thinking about how change at the organizational level is accomplished. Bennis et al.'s classic *The Planning of Change* (1985:24-43) groups available change mechanisms into the strategies that reflect the different theories about how *people* can be induced to change:

- Educative/empirical-rational strategies, which posit that individuals, guided by reason, will utilize some rational calculus of self-interest to determine needed changes in behavior. Knowledge is a major ingredient of power in these strategies.
- Normative/persuasive strategies, which posit that individuals are guided by internalized meanings, habits, and values. These strategies emphasize the importance of balancing knowledge about technologies and systems with knowledge and understanding of non-cognitive determinants of behavior, including processes of persuasion and collaboration.
- Power-coercive strategies, which emphasize political and economic sanctions and regulatory strategies as ways to amass political and economic power behind change goals. These strategies include nonviolent protests, use of political institutions, and manipulation of the alignment and composition of the power elite.

Meyer et al. (1990) add mimetic strategies, which are designed to promote change by providing examples and the models.

Dooley (1997:69) observes that the "prevailing paradigm of a given era's management theories has historically mimicked the prevailing paradigm of that era's scientific theories." During the nineteenth and early twentieth centuries, management theories held reductionism, determinism, and equilibrium as core principles (the organization as a machine metaphor), and accorded management near total authority over the workplace – in other words, an autocratic management model (the power-coercive strategy described above).

Although contemporary management practice remains deeply rooted in the mechanistic, equilibrium approach and an autocratic model of management, it is increasingly influenced by an organic construct of the organization that emphasizes organization-external environment interactions, teamwork and participation, worker motivation, and the dynamic aspects of change, adaptation, and learning (Morgan 1986; Wheatley 1992). The work of Mayo (1933), Likert (1961), McGregor (1960) and Trist (1981), along with many others, laid the foundation for this growing emphasis on balancing technical aspects of organizational design with consideration of the needs and interests of the workers and the constraints and opportunities presented by the external environment. Indeed, a substantial focus in the change management literature is helping organizations, and top management, change their management model and their managers' behaviors.

Kurt Lewin's (1951, 1958) three-phase model of change -- unfreeze[2], move or change, and refreeze –provides the framework for much of the literature that deals with intentional change in organizations (Goodstein and Burke 1995; Sapienza 1995; Kotter 1998; Goss et al. 1998). An important aspect of this framework is the centrality of changing the individuals who comprise the organization and the explicit recognition that change will be resisted, and that overcoming this resistance requires leadership (and hence the involvement of top management) and creates costs, which in the case of individuals include substantial emotional work. Conflict theory, action research, and discrepancy theory are employed to articulate and address the individual and interpersonal aspects of change (Dannemiller and Jacobs 1992). Lewin identified three ways that organizational change could be accomplished:

- Changing the individuals who work in the organization (their skills, values, attitudes and eventually behavior) – with an eye to instrumental organizational change
- Changing various organizational structures and systems – reward systems, reporting relationships, work designs
- Directly changing the organizational climate or interpersonal style – how often people are with each other, how conflict is managed, how decisions are made.

Robertson and Seneviratne (1995) add changes in technology and physical setting to the ways change can be accomplished, which they group with organization arrangements and social factors into a category they label *organizational work setting*. As illustrated in Figure 3, their model of the organizational change process has three phases: (a) planned interventions create changes in the organization work setting; (b) these changes in the work setting lead individuals to change their behavior; (c) these individual behavioral changes impact organizational performance and individual development, the key organization outcomes. Others involved in this discussion would emphasize that the intervention strategy needs to be driven by vision and strategy (Beckhard and Harris 1978), and that the arrows linking the components should be double-headed, reflecting the interactive nature of the components in the change process.

Underlying discussions of change strategies are two different models of behavioral change (Sapienza 1995). The first views behavior as a function of attitude, with attitude change seen as driving changes in behavior – i.e., change attitudes and behavior will follow (Lewin 1951, 1958). The second views behavior as a function of context, with changes in context seen as driving changes in behavior – i.e., change the context and behavior will follow. The tension between these two models and the basis for choosing one approach over another in a particular circumstance has been a key focus of change management literature and research. Although the debate continues, there is increasing recognition that a balanced approach that employs mutually reinforcing interventions, tailored to the particular circumstances and history of the organization, to change both attitudes and context is likely to be the most effective in creating the desired change (Sapienza 1995; Beer and Nohria 2000; Heifetz 1994; Senge 1990; Senge et al. 1999).

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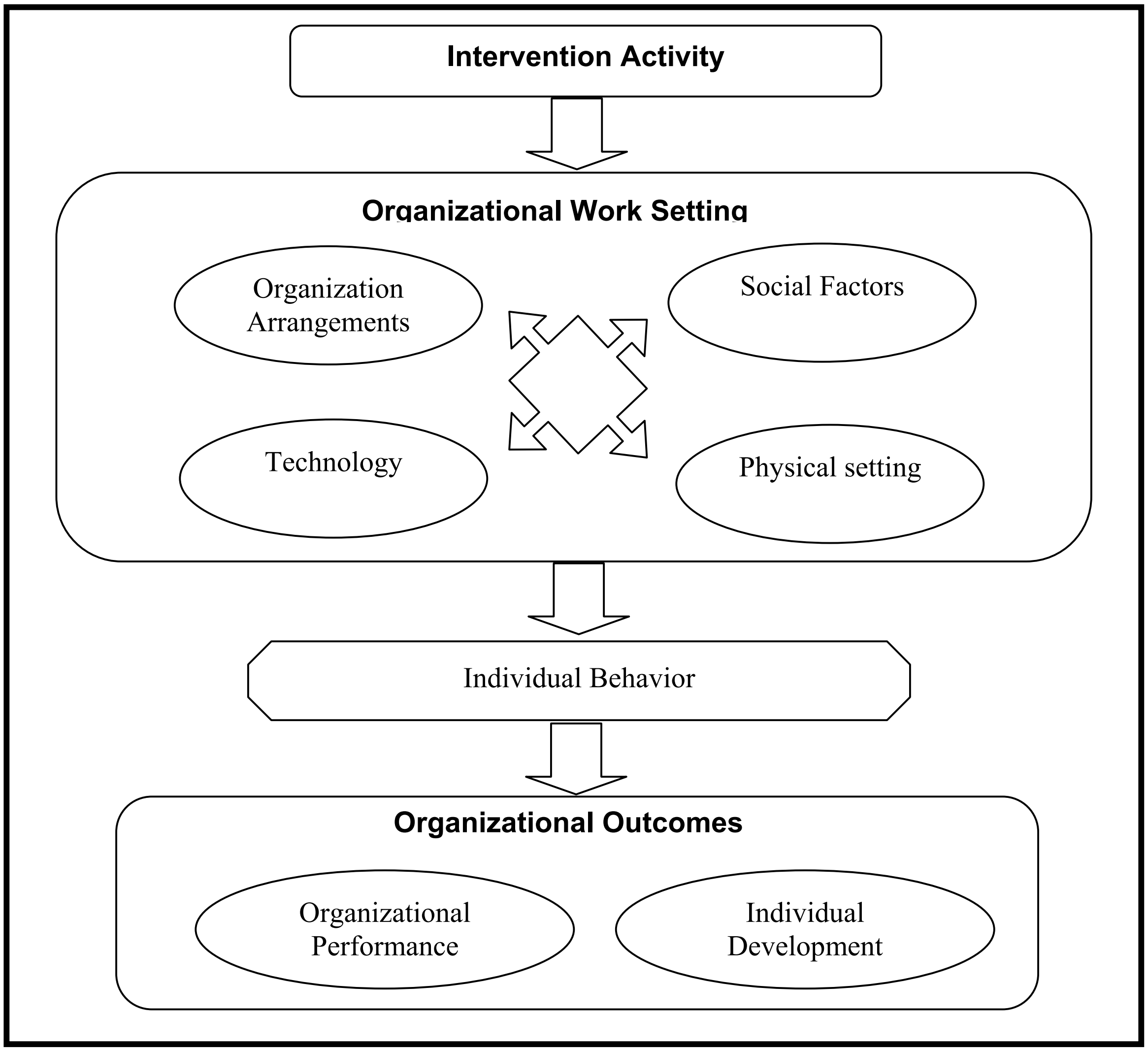
[2] This phase is sometimes divided into: (a) producing a felt need for change, and (b) unfreezing.


Intervention Activity
Organizational Work Setting
Organization Arrangements
Social Factors
Technology
Physical setting
Individual Behavior
Organizational Outcomes
Organizational Performance
Individual Development

Source: Adapted from Robertson, Peter J., and Sonal J. Seneviratne. 1995. Outcomes of Planned Organizational Change in the Public Sector. *Public Administration Review* 55(6):550.

Figure 3. A Theoretical Model of the Dynamics of Intentional Organizational Change

Beer and Nohria (2000:133) illustrate how these two archetypes/models of change are reflected in the business world. They note that there are contradictions between the two models and the change strategies that follow from them. They argue that change managers can start with an approach based on changing the context (economic value theory, E) and then follow with changes based on changing attitudes (organizational capability theory, O), but not the reverse due to the loss of trust caused by the tough actions associated with aggressive change in context (Theory E). Because this sequential approach takes time, they advocate an integrated approach, emphasizing that success depends upon explicitly confronting the tension between the goals of creating organizational economic value and creating organizational capability, a point emphasized throughout this literature. A graphic representation of this theory is shown in Table 1.

Table 1. Addressing the Tensions between Competing Change Management Strategies

Dimensions of Change	**Economic Value Theory (E)**	**Organizational Capability Theory (O)**	**Theories E and O Combined**
Goals	Maximize shareholder value	Develop organizational capabilities	Explicitly embrace the paradox between economic value and organizational capability
Leadership	Manage change from the top down	Encourage participation from the bottom up	Set direction from the top and engage the people below
Focus	Emphasize structure and systems	Build up corporate culture: employees' behavior and attitudes	Focus simultaneously on the hard (structures and systems) and the soft (corporate culture)
Process	Plan and establish programs	Experiment and evolve	Plan for spontaneity
Reward System	Motivate through financial incentives	Motivate through commitment—use pay as fair exchange	Use incentives to reinforce change but not to drive it
Use of Consultants	Consultants analyze problems and shape solutions	Consults support management in shaping their own solutions	Consultants are expert resources who empower employees

Source: Beer, Michael, and Nitin Nohria. 2000. Cracking the Code of Change. *Harvard Business Review* 78(2 March-April):136-137.

Among the other organizational change theories that play a key role in the change management literature are lifecycle and growth stage theories (Adizes 1999; Greiner 1967, 1998), which emphasize the importance of the predictable life stages of an organization that drive change and create change management demands; and cultural change (Cameron and Quinn 1999; Burke and Trahant 2000), which incorporates both learning theory and action research (Argyris and Schön 1978; Argyris 1993; Heifetz 1994; Wheatley 1992) and participation/engagement theory (Strebel 1998; Heifetz 1994; Holman and Devane 1999). Christensen and Overdorf's (1999) theory of disruptive change has had a widespread impact on change management thinking, as discussed below.

Approaches and Tools of Change Management

Much of the change management literature continues to reflect a mechanistic view of organization and management, with an expectation of relatively straightforward cause and effect relationships between the factors that stimulate change, the change initiatives or interventions undertaken in response to those stimuli, and outcomes that will result from those initiatives. Recently, particularly in discussions about the challenges posed by disruptive changes in technology and the external environment and organizations that diverge from the dominant hierarchical bureaucratic form, there is growing debate about the ability of logical, empirical analysis to provide the insight and creative response needed for successful transition or transformation. Critics have suggested that the change management literature has been subject to fads and hyperbole, reaching "evangelical proportions" of advocacy for change management strategies such as business process re-engineering and total quality management while failing to incorporate sound principles of organizational design (McNamara 1999; MacDonald 1998).

Reflecting the sustained interest in organizational change and change management, a wide variety of tools have been developed to both initiate and manage organizational change and to control and direct change caused by unplanned disruptions. Many of the most popular tools are focused on achieving quality improvements; addressing worker concerns; and enhancing flexibility by changing organizational structure, processes, people, and/or culture. Nadler and Tushman (1997), Lawler et al. (1992, 1998, 2001) and others emphasize that the choice of approach or tool depends upon the organization's nature, resources, and problems, and must be tailored to the specific contest and organization.

McNamara (1999) compiled an overview of the tools and approaches for organizational change and improvement that are used in change management. Jacobs (1994), Mohrman and Mohrman, Jr. (1993), Miles (1997), and Nadler and Tushman (1997), identify the following as candidate tools and approaches, many of which are addressed in considerable detail in other chapters of this book:

- Backward Mapping (start with the end in mind, working backward from the desired end state to identify pathways to success)
- Balanced Scorecard (ensure well-rounded performance, especially from managers, by designing an evaluation that takes into account the perspective of clients/customers, manager, peer, and subordinate on four dimensions: customer service, internal business processes, learning and growth, and financials)
- Benchmarking (use standards or measures from high performing organizations as basis for comparison – results from benchmarking need to be used as part of an overall change process; just doing the benchmarking doesn't lead to change)
- Business Process Reengineering (increase performance by radically redesigning the organization's structures and processes, including starting over from the ground up)
- Continuous Improvement (improve performance and customer satisfaction through continuous and incremental improvements to processes, including removing unnecessary activities and variations – often represented as a quality initiative)
- Cultural Change (accomplish radical and fundamental change by changing the basic values, norms, beliefs, etc., among members of the organization)
- Employee Involvement (engaging personnel from throughout the organization to identify issues, propose solutions, and become partners in implementing the changes needed to succeed in present and future environments).

- ISO9000 (implement internationally recognized standards of performance and quality using guidelines especially focused on environmental performance)
- Knowledge Management (collect and manage critical knowledge in an organization to increase its capacity for achieving results, often involving extensive use of computer technology – impact depends on how well the enhanced, critical knowledge is applied to the organization)
- Learning Organization (enhance organizational systems (including people) to increase capacity for performance -- impact depends upon how well the enhanced ability is applied in the organization)
- Management by Objectives (align goals and subordinate objectives throughout the organization – a form of planning)
- Organizational Design (redesign the organization to address inadequacies and build new, more appropriate capabilities and processes, including organizational self-design and learning)
- Outcome-Based Evaluation (assess impact of services and products on target communities, identify outcomes necessary to accomplish objectives with target market, construct measures for each outcome to assess extent of achievement)
- Total Quality Management (ensure that the organization consistently meets or exceeds customer requirements and continually improves by measuring processes and imposing controls)

Factors Important to Successful Change Management

There is increasing emphasis on the need to tailor change management strategies to the particular characteristics of the organization and its environment and to address all aspects of the organization during implementation. Even then Christensen and Overdorf (2000) emphasize how difficult it can be to meet the simultaneous demands of the current organization and its business needs and those of the emerging conditions. There is general agreement that success is unlikely unless the following basic considerations are addressed effectively. This requires not only skilled management but also effective leadership and broad employee engagement and participation.

Providing Alternative Spaces and Structures for Change

Christensen (1997) and Christensen and Overdorf (2000) provide an extremely lucid discussion of the challenges facing organizations trying to respond to discontinuous and disruptive changes in the external environment and the critical role an informed and appropriate strategy plays in management's ability to chart a course that enables the organization to succeed under these difficult circumstances. Frequently, the strategy for success is not easy to determine since many aspects of the changing environment are still emerging and are highly uncertain. This places a premium on rapid recognition of changing conditions that require a change in strategy, and a thorough understanding of the capabilities, values, and processes of the organization, which determine the organization's ability to implement a strategy. Miles (1997) emphasizes that transforming change is vision-led rather than problem-driven.

Christensen and Overdorf (2000), Sull (1999), and Miller and Morris (1999) highlight the strategy issues created by the tradeoffs organizations face when dealing with disruptive or discontinuous change: execute current business effectively or adapt to meet the new needs.

Processes and values, which constitute valuable resources for conducting the organization's current business, can become constraints on the organization's ability to succeed in the changed environment. Processes by definition are not meant to change, or need tightly controlled procedures to manage the change; changing them takes time and effort. Values influence judgments about the type of business the organization can conduct (for example, acceptable margins and the types of projects/products that are within the organization's "market," including how big an opportunity has to be to be interesting). Values are also difficult to change. Consequently, when "the organization's capabilities reside primarily in its people, changing capabilities to address the new problems is relatively simple. But when the capabilities have come to reside in processes and values, and especially when they have become embedded in culture, change can be extraordinarily difficult" (Christensen and Overdorf 2000:71). Processes are not nearly as flexible or adaptable as resources, and values are even less so. So when an organization needs new processes and values, because it needs new capabilities, it must create a new organizational space where those capabilities can be developed in several ways: (1) creating new organizational structures within the corporate boundaries where new processes can be developed, (2) spinning out an independent organization from the existing organization, or (3) acquiring a different organization whose processes and values closely match the requirements of the new task. These alternatives obviously have implications for the existing organization as well as the demands placed on the organization's leadership, as illustrated in Table 2.

Table 2. Strategies for Enhancing Effective Change Response

Requirements of New Opportunities	**Good Fit with Organization's Values about Type of Business Opportunities**	**Poor Fit with Organization's Values about Type of Business Opportunities**
Poor Fit with Organization's Processes	Use a heavyweight team (the relevant people pulled out of their existing organization acting as general managers for the new initiative), but operating within the existing organization	Use a heavyweight development team (the relevant people pulled out of their existing organization acting as general managers for the new initiative), in a separate spin-out organization
Good Fit with Organization's Processes	Use a lightweight team (a cross functional team matrixed from their existing positions) operating within the existing organization	Development may occur in-house through a heavyweight team (the relevant people pulled out of their existing organization acting as general managers for the new initiative), but commercialization almost always requires a spinout

Source: Christensen, Clayton M., and Michael Overdorf. 2000. Meeting the Challenge of Disruptive Change. *Harvard Business Review* 78(2 March-April):75.

Note: The idea of heavyweight teams was developed by Kim Clark and Steven Wheelwright (1997).

Leadership

Executive sponsorship and participation are critical to the success of change initiatives. Numerous studies have identified leadership and participation by top management as the single greatest contributor to success in change management programs (Kanter 1983; Kanter et al. 1992; Goodstein and Burke 1995). Mohrman and Mohrman (1993), Lawler et al. (1993) and others stress that change leadership must be diffused throughout the organization and an effective leadership network established to overcome resistance and inertia within the organization. Among the requirements of leadership during planned organizational changes are the courage to confront resistors and deal proactively with conflict, the ability to provide vision and coherence (linkages that hold the organization together), and the ability to motivate and overcome resistance (Pasternack and Viscio 1998; Baldwin and Clark 1997; Marshall 2000). Bennis and O'Toole (2000) note that the right CEO can make or break a company, in part because of the CEO's role in initiating and leading planned change.

Leaders are needed to provide vision, inspiration, and conviction and to demonstrate integrity, provide meaning, generate trust, and communicate values. They must also know how to pace and sequence change efforts to avoid change fatigue and cynicism (Abrahamson 2000). Goleman's (2000:81) extensive study (random sample of 3,871 executives) found that a key aspect of leaders' effectiveness during change was their ability to apply different styles of leadership to different circumstances, even within short time periods. This was because different leadership styles (coercive, authoritative, affiliative, democratic, pacesetting, coaching) have different effects on aspects of organizational climate (flexibility, responsibility, standards, rewards, clarity, commitment) that affect the success of planned change in different circumstances. This finding is also consistent with Fiedler's (1996) study on the contingent leadership. Nystrom and Starbuck (1984) emphasize the importance of top managers' ideas on organizational learning, and the potential need to replace top managers en masse in order to enable the organization to unlearn dysfunctional approaches and respond effectively to crisis situations.

Pascale et al. (1997:127) reflect much of the literature in the three interventions they recommend to leaders for restoring companies to "vital agility" and keeping them in good health:

- Incorporate employees fully into the principal business challenges facing the company
- Lead the organization in a different way to sharpen and maintain employee involvement and create constructive stress by raising issues and generating urgency
- Instill mental disciplines that encourage people behave differently and then help them sustain their new behavior.

Recognition of and Attention to the Personal Aspects of Change

Managing the social psychology of the workplace is critical for successful organizational change. Consequently, a substantial segment of the change management literature focuses on describing how managers and employees respond to change and advising managers and staff about how to handle the stress, conflicts, and emotional issues that accompany change, gain support for and participation in the change effort, and generally, make organization-wide change less traumatic. (See Adizes 1991, 1999; Argyris 1993; Heifetz 1994; Holman and Devane 1999; Kotter 1998; Marquardt 1999; Marshall 2000; Woodward and Buchholz 1987). Throughout this literature managers are advised to recognize that change is implemented by and has consequences for people, and that change can be made significantly less traumatic and more successful if these human aspects are anticipated and handled effectively. An entire literature has developed emphasizing the importance and impact of involving employees effectively in organizational decision making and change initiatives. Widespread involvement, use of tools such as future search, real-time strategic change, and open space processes can enable a critical mass of organizational members participate in understanding the need for change and the ability to coalesce around the future vision.

A key message is that during times of change, communication and employee engagement are more important than usual and can substantially affect the cost and outcome of change efforts. Trust is identified as particularly important in obtaining support for and participation in change efforts (Adizes 1991; Duck 1998; Marshall 2000). Strebel (1998 [1996]:139) emphasizes that executives and employees see change differently, with senior managers typically seeing change as opportunity, for both the business and themselves, and employees typically seeing change as disruptive, intrusive, and likely to involve loss. These aspects of change are very personal and need to be addressed in personal terms. It is important for those managing change to identify the key issues that may range from loss of turf, attachment, meaning, future, competency-based identity, and/or control. It is in the discussions of the human aspects of change that Lewin's three-stage model of unfreezing, move or change, and refreezing is most frequently applied. In designing change initiatives, cautions are made concerning the difficulty of and time required to create new values within an organization.

In-Depth Understanding of the Existing Organization, Its Lifecycle or Developmental Stage, and Its Environment

The literature consistently emphasizes the danger of embarking on organizational change without conducting an organizational assessment to ensure an understanding of the key elements of the organization's performance. This information is then combined with information about the external environment and the future vision to develop the change strategy. The organizational assessment needs to take into consideration where the organization is in the growth and evolution/development (lifecycle) process so that the change process can work "with the flow of the tide rather than against it." (Greiner 1998:8). There is a substantial component of the literature that describes the attributes of the different lifecycle stages and how to conduct such an assessment (Adizes 1999; Greiner 1968; Pascale et al. 1997; Sull 1999). The point is frequently made that the solutions to the problems experienced during one lifecycle change are exactly what breeds new problems as the organization continues to grow and mature, and that organizations frequently have difficulty letting go of previously successful strategies, even when they are no longer useful (Greiner 1998; Skarke et al. 1995).

In fact, there is a significant literature on the importance of 'unlearning" as part of the change process. Tools such as change-boards have been identified as effective tool to assess current versus desired stance of stakeholders and in maintaining focus on the gaps between existing and future needs and the areas that require greater attention and effort. Ackoff (1999), Hedberg et al. (1976) and Wheatley (1992) emphasize the importance of action learning and a learning and experimental approach to change, particularly in the complex, highly interconnected systems typical of knowledge-based organizations.

Balance and Organizational Learning to Make Strategic and Effective Use of Change Mechanisms

Dooley (1997:92) and others emphasize that the convergent and divergent forces at play during a change process must be balanced, not in a linear, additive way, but in an organic fashion. Kotter (1998), Abrahamson (2000), Christensen and Overdorf (2000) and others emphasize the importance of a systematic and comprehensive approach, and the importance of recognizing the amount of time and effort required to fully implement a transformational change (on the order of ten years). While acknowledging the non-linear aspects of the change process, it is still useful for organizational leaders to analyze available information to identify what needs to be changed in order to prepare the organization to be successful in its current and future environment. Mohrman, Jr. et al. (1989), Ackoff (1999), Hedberg et al. (1976). This leads to general guidelines for an effective change management process:

- Create a shared purpose

- Cultivate inquiry, learning, experimentation, and divergent thinking
- Enhance external and internal interconnections via communication and technology
- Instill rapid feedback loops for self-reference and self-control
- Cultivate diversity, specialization, differentiation, and integration
- Create shared values and principles of action
- Make explicit a few but essential structural and behavioral boundaries
- Plan to implement change over the long term, following periods of intense change with periods of consolidation.

Strategies for effecting cultural change drawn from the organizational culture literature include (Schein 1999):

- Unfreezing the old culture and creating motivation to change
- Capitalizing on propitious moments—problems, opportunities, changed circumstances, and/or accumulated excesses or deficiencies of the past
- Making the change target concrete and clear
- Maintaining some continuity with the past
- Creating psychological safety through a compelling positive vision, formal training, informal training of relevant groups and teams, providing coaches and positive role models, employee involvement and opportunities for input and feedback, support groups, and addressing fears and losses head on
- Selecting, modifying, and creating appropriate cultural forms, behaviors, artifacts, and socialization tactics
- Cultivating charismatic leaders
- Having a realistic and solid transition plan
- Exercising risk management, and understanding and addressing the risks and benefits.

Outcomes and Consequences of Change Initiatives: The Risk of Failure

Change management proponents have also been criticized for failing to conduct the evaluations necessary to document and clarify the results of change management initiatives, examine their cost effectiveness, and acknowledge the difficulty, costs, and complexity of managing organization-wide change (MacDonald 1998; Kotter 1998; Abrahamson 2000). Indeed, the value of planned change has been challenged, with some studies indicating that most change management initiatives fail while exerting heavy economic and human tolls on the organization (Beer and Nohria 2000:133).

Although the change management literature generally recognizes the need for change initiatives, the potential for failure is great. The Harvard Business School tracked the impact of change efforts among the Fortune 100 and found that all companies had implemented at least one change program between 1980 and 1995, but only 30 percent produced an improvement in bottom-line results that exceeded the company's cost of capital (Pascale et al. 1997:139). Beer and Nohria (2000:133) found that about 70 percent of change initiatives fail.

Reasons for failure include:

- The key to achieving and sustaining significant change is changing the basic ways of thinking within the organization, but this is difficult to achieve and sustain (Senge et al. 1999). Companies resist new truths with a great deal of emotion (Martin 1998:114).
- Change management requires leadership, poses both personal and organizational stresses and challenges, and, if not done or done poorly makes things worse (Goodstein and Burke 1995:7). Even when an organization can figure out what to do, it still has to figure out how to make goals and methods transparent enough that employees are willing to take some calculated risks (Martin 1998:137).
- Change needs to be implemented over the long term, with careful attention to the disruptive aspects of change management. Periods of intense change need to be followed by periods of consolidation. Organizations need to plan for ten years of effort to accomplish a major transformational change (Kotter 1998). Skipping steps creates only an illusion of speed and never produces a satisfying result. Critical mistakes in any of the phases can have a devastating impact, slowing momentum and negating previous gains (Kotter 1998:2).
- Because of the need to maintain a capability to conduct existing business during the interim and the entrenched structures and practices that must be overcome, there is general agreement that it may be easier to create the necessary conditions in new organizations than in existing organizations.

The Application of Change Management to Public Science Management

Science management organizations have varied in their ability to respond to and manage change. At the level of basic research activities, communication among scientists may be sufficient to lead research activities into pertinent and promising areas. However, the rigidities of federal bureaucracies and the complex budget and justification processes may tend to delay the initiation of new programs and to burden such programs with defined milestones and outputs inappropriate for state-of-the-art research. Thus, understanding the processes of change and the ability to manage changes in basic research are essential tools for the science manager.

This literature indicates that managers of science organizations, both public and private, need to be “environmentally vigilant,” carefully monitoring and analyzing the external environment to identify and analyze changes that could significantly alter the “rules of the game” and indicate a need for organization-wide change within their organization (Burke and Trahant 2000). Forces such as globalization, the movement to “centerless organizations” in which organizational boundaries are altered by partnerships and network interactions, redefinitions of US strategic interests and the role of science in national security, a changing political climate that dictates new, more extensive, or different partnerships in either the funding or execution of science, breakthroughs that change definitions of disciplinary boundaries, competition, or requirements for collaboration, events such as terrorist attacks or heightened concern about spies and the protection of classified information are examples of the types of changes in the external environment that could have major consequences for the strategy and operations of the organizations that fund and conduct public science.

On the positive side, many of the skills and attributes most important for successful organizational change are those already well represented in the organizations involved in science management: expectation of change, appreciation for the unexpected nature and consequences of discovery and innovation, and extensive networks and collaborations that routinely bring outside information into the organization. This literature provides a rich mixture of theory, conceptual frameworks, guides, and case studies that, collectively, convey the wide range of options, complexity, and challenges of managing organizations through voluntary or involuntary change. It can help leaders of public science organizations understand and interpret the challenges facing their organizations and arm themselves with the tools needed to develop a set of change strategies that are tailored specifically for the particular combination of bureaucratic hierarchy and knowledge-based organizations they inhabit.

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